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where CTL epitopes tended to cluster. HLA restriction was determined CTL responsive to four of the peptides. Among the four epitopes that had determined HLA specificities were the two peptides in the study that proved to stimulate CTL from the highest fraction of the cell lines: peptide p24(263-272) HLA-B27 and peptide p24(256-270) HLA-A33; these peptides were each able to stimulate CTL response from 14% of the cell lines.

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NOTE: (Medline: 93233253) In this study the ability of HIV-1-specific CTL clones derived from seropositive persons to release gamma interferon (IFN-γ), tumor necrosis factor alpha (TNF-α), and TNF-β upon contact with target cells presenting viral antigen was assessed. Epitopes: p17: KIRLRPGGKKKYKLKHIVWASRELE, A3; gp41: VERYLKDQQL, B14 and A28; ERYLKDQQL, B14; RT: AIFQSSMTK-ILEPFRKQNPDIVIYQ, A11; and nef SQRRQDILDLWIYHTQGYFPDWQNY, B13.

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NOTE: (Medline: 93233253) In this study the ability of HIV-1-specific CTL clones derived from seropositive persons to release gamma interferon (IFN-γ), tumor necrosis factor alpha (TNF-α), and TNF-β upon contact with target cells presenting viral antigen was assessed. Epitopes: p17: KIRLRPGGKKKYKLKHIVWASRELE, A3; gp41: VERYLKDQQL, B14 and A28; ERYLKDQQL, B14; RT: AIFQSSMTK-ILEPFRKQNPDIVIYQ, A11; and nef SQRRQDILDLWIYHTQGYFPDWQNY, B13.

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NOTE: (Medline: 95169519) Volunteers were immunized with recombinant vaccinia virus expressing HIV-1 gp160 (vac-env) and boosted with recombinant gp160 (rgp160). CTL clones were analyzed for HLA restriction and specificity. An immunodominant HLA-A3.1 restricted epitope was observed that showed very little sequence variation among B subtype sequences, (TVYYGVPVWK). Naturally occuring variants of this peptide were able to stimulate reactivity. Two additional CD8+ CTL epitopes from vaccinees were characterized, as well as two CD4+ CTL epiotpes.

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NOTE: (Medline: 94202302) In two volunteers, immunization with a single strain of HIV-1 induced CD4+ and CD8+ CTL that are specific for multiple conserved regions of HIV-1 and would be expected to recognize a broad range of viral isolates. The immunodominant gp120 epitope, gp120 TVYYGVPVWK, elicited CD8+ HLA-A3.1 restricted CTL, and this epitope is highly conserved. CTL specific for this epitope could lyse target cells sensitized with all known natural sequence variants. Additionally, CD8+ HLA-B35 and CD8+ HLA-B18 restricted epitopes were defined as well as two CD4+ cytotoxic T-cell gp120 epitopes: ITQACPKVSFEPIPHYCAPAGFAI and NNTLKQIDSKLREQFG.

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NOTE: (Medline: 93017933) CTL clones derived from CSF of individuals with AIDS dementia. HIV-1 specific CTL were detected in CSF from 5 out of 6 patients who were suffering from HIV-1 associated cognitive/motor complex disturbances.

[Johnson (1994a)] R. P. Johnson, S. A. Hammond, A. Trocha, R. F. Siliciano, & B. D. Walker. Epitope specificity of MHC restricted cytotoxic T lymphocytes induced by candidate HIV-1 vaccine. *AIDS Research and Human Retroviruses* **189**:35–63, 1994a.
NOTE: (Medline: 95169519) Volunteers were immunized with recombinant vaccinia virus expressing HIV-1 gp160 (vac-env) and boosted with recombinant gp160 (rgp160). CTL clones were analyzed for HLA restriction and specificity. An immunodominant HLA-A3.1 restricted epitope was observed that showed very little sequence variation among B subtype sequences, (TVYYGVPVWK). Naturally occuring variants of this peptide were able to stimulate reactivity. Two additional CD8+ CTL epitopes from vaccinees were characterized, as well as two CD4+ CTL epiotpes.

[Johnson (1994b)] R. P. Johnson, S. A. Hammond, A. Trocha, R. F. Siliciano, & B. D. Walker. Induction of a major histocompatibility complex class I-restricted cytotoxic T-lymphocyte response to a highly conserved region of human immunodeficiency virus type 1 (HIV-1) gp120 in seronegative humans immunized with a candidate HIV-1 vaccine. *J Virol* **68**:3145–3153, 1994b.
NOTE: (Medline: 94202302) In two volunteers, immunization with a single strain of HIV-1 induced CD4+ and CD8+ CTL that are specific for multiple conserved regions of HIV-1 and would be expected to recognize a broad range of viral isolates. The immunodominant gp120 epitope, gp120 TVYYGVPVWK, elicited CD8+ HLA-A3.1 restricted CTL, and this epitope is highly conserved. CTL specific for this epitope could lyse target cells sensitized with all known natural sequence variants. Additionally, CD8+ HLA-B35 and CD8+ HLA-B18 restricted epitopes were defined as well as two CD4+ cytotoxic T-cell gp120 epitopes: ITQACPKVSFEPIPHYCAPAGFAI and NNTLKQIDSKLREQFG.

[Johnson (1992)] R. P. Johnson, A. Trocha, T. M. Buchanan, & B. D. Walker. Identification of overlapping HLA class I-restricted cytotoxic T-cell epitopes in a conserved region of the human immunodeficiency virus type 1 envelope glycoprotein: definition of minimum epitopes and analysis of the effects of sequence variation. *J Exp Med* **175**:961–971, 1992.
NOTE: (Medline: 92202878) Fine mapping and mutational analysis of gp41 epitopes: ERYLKDQQL, HLA B14 and YLKDQQLL, HLA B8.

[Johnson (1993)] R. P. Johnson, A. Trocha, T. M. Buchanan, & B. D. Walker. Recognition of a highly conserved region of human immunodeficiency virus type 1 gp120 by an HLA-Cw4-restricted cytotoxic T-lymphocyte clone. *J Virol* **67**:438–445, 1993.
NOTE: (Medline: 93100827) The epitope sequence FNCGGEFF stimulates CTL response; the natural variants FNCRGEFF (SF2), TNCRGEFL (ROD) and LNCGGEFF (NDK) do not serve as epitopes. This was the first report of an HIV antigen specific target cells restricted by an HLA-C molecule, Cw4.

[Johnson (1991)] R. P. Johnson, A. Trocha, L. Yang, G. P. Mazzara, D. L. Panicali, T. M. Buchanan, & B. D. Walker. HIV-1 gag-specific cytotoxic T lymphocytes recognize multiple highly conserved epitopes. fine specificity of the gag-specific response defined by using unstimulated peripheral blood mononuclear cells and cloned effector cells. *J Immunol* **147**:1512–1521, 1991.
NOTE: (Medline: 91349569) This study presented a detailed study of gag specific CTL from HIV-1 seropositive individuals. Seven p24 and two p17 epitopes were described, that were recognized by class I restricted CD3+CD8+ CTL. p17 epitopes: KIRLRPGGKKKYKLKHIVWAS-

RELE and QTGSEELRSLYNTVATLYCVHQRIE; p24 epitopes: NPPIPVGEIYKRWIILGLNKIV, VHQAISPRTLNAWVKVVEEKAF, NAWVKVVEEKAFSPEVIPMFSA, SALSEGATPQDLNTMLNTVGGH, GHQAAMQMLKETINEEAAEWDR, and RAEQASQEVK.

[Johnson & Walker(1994)] R. P. Johnson & B. D. Walker. CTL in HIV-1 infection: Responses to structural proteins. *Curr Topics Microbiol Immunol* **189**:35–63, 1994.
NOTE: (Medline: 95008926) review.

[Kalams (1994)] S. Kalams, R. P. Johnson, A. K. Trocha, M. J. Dynan, H. S. Ngo, R. T. D'Aquila, J. T. Kurnick, & B. D. Walker. Longitudinal analysis of T-cell receptor (TCR) gene usage by HIV-1 envelope-specific cytotoxic T-lymphocyte clones reveals a limited TCR repertoire. *J. Exp. Med.* **179**:1261–1271, 1994.
NOTE: (Medline: 94194282) This paper presents an in depth longitudinal study of T-cell receptor gene usage to a well defined HLA B14 restricted gp41 epitope. Ten CTL clones were derived from a single individual over 31 months. T-cell receptor V-D-J sequencing was performed on PCR amplification products. All ten clones utilized Vα14 and Vβ4 genes; observed limited T-cell receptor diversity to an immunodominant epitope was suggested to facilitate immune escape. gp41 epitope: ERYLKDQQL. An HLA B14 restricted RT epitope from this individual used Vα21 and Vβ14, showing use of these genes was not a feature of all HLA B14 restricted clones from this individual. RT epitope: AIYLALQDSGLEVNIVTDSQYALGI.

[Kast (1994)] W. M. Kast, R. M. Brandt, J. Sidney, J. W. Drijfhout, R. T. Kubo, H. M. Grey, C. J. Melief, & A. Sette. Role of HLA-A motifs in identification of potential CTL epitopes in human papillomavirus type 16 E6 and E7 proteins. *J Immunol* **152**:3904–3912, 1994.
NOTE: (Medline: 94194153) Binding affinities for five HLA-A alleles: HLA-A1 (A*0101), A2.1 (A*0201), A3 (A*0301), A11 (A*1101), and A24 (A*2401) was determined for all nonamer peptides of human papillomavirus type 16 E6 and E7. High affinity binding peptides allowed an assessment of binding-motifs.

[Klenerman (1994)] P. Klenerman, S. Rowland-Jones, S. McAdam, J. Edwards, S. Daenke, D. Lalloo, B. Koppe, W. Rosenberg, D. Boyd, A. Edwards, P. Giangrande, R. E. Phillips, & A. J. McMichaels. Cytotoxic T-cell activity antagonized by naturally occurring HIV-1 Gag variants. *Nature* **369**:403–407, 1994.
NOTE:(Medline: 94255016) These paper documents that naturally occurring peptide variants can serve as antagonists, that is they can inhibit normal lysis of cells presenting the original epitope. The variants studied could serve as antagonists when they were processed from recombinant vaccinia, replicated HIV, or when they were synthetic peptides. Both agonist and antagonist sequences were found in the study subjects from whom the CTL clones were derived.

[Koenig (1990)] S. Koenig, T. R. Fuerst, L. V. Wood, R. M. Woods, J. A. Suzich, G. M. Jones, V. F. de la Cruz, R. T. Davey Jr., S. Venkatesan, B. Moss, W. E. Biddison, & A. S. Fauci. Mapping the fine specificity of a cytotoxic T-cell response to HIV-1 nef protein. *J Immunol* **145**:127–135, 1990.
NOTE: (Medline: 90293448) A 10 residue peptide that triggers CTL in association with the HLA A3.1 molecule was studied. Human cell transfectants were used to map a critical residue in the HLA A3.1 molecule for recognition, amino acid 152, which is present on the alpha-2 helix in HLA-A3.1 and is modified in the HLA A3.2 A3 allel.

[Layton (1993)] G. T. Layton, S. J. Harris, A. J. Gearing, M. Hill-Perkins, J. S. Cole, J. C. Griffiths, N. R. Burns, A. J. Kingsman, & S. E. Adams. Induction of HIV-specific cytotoxic T lymphocytes in vivo with hybrid HIV-1 V3:Ty-virus-like particles. *J Immunol* **151**:1097–1107, 1993.
NOTE: (Medline: 95271010) V3-Ty-Virus-like particles can induce type specific CTL in mice in the absense of adjuvant.

[Lieberman (1992)] J. Lieberman, J. A. Fabry, M. Kuo, P. Earl, B. Moss, & P. R. Skolnik. Cytotoxic T lymphocytes from HIV-1 seropositive individuals recognize immunodominant epitopes in gp160 and reverse transcriptase. *J Immunol* **148**:2738–2747, 1992.
NOTE: (Medline: 92242898) This paper does not use T-cell clones to map epitopes, but rather T-cell lines from HIV infected donors. 20 amino acid peptides were used of map the region of the reactive epitopes. HLA restriction was not tested for all epitopes.

[Littaua (1991)] R. A. Littaua, M. B. A. Oldstone, A. Takeda, C. Debouck, J. T. Wong, C. U. Tuazon, B. Moss, F. Kievits, & F. A. Ennis. An HLA-C-Restricted CD8+ cytotoxic T-Lymphocyte clone recognizes a highly conserved epitope on human immunodeficiency virus type 1 gag. *J Virol* **65**:4051–4056, 1991.
NOTE: (Medline: 91303653) Fine mapping of gag p24 epitope with HLA-C restriction: QAISPR, HLA, Cw3.

[Macatonia (1991)] S. E. Macatonia, S. Patterson, & S. C. Knight. Primary proliferative and cytotoxic T-cell responses to HIV induced in vitro by human dendritic cells. *Immunology* **74(3)**:399–406, 1991.
NOTE: (Medline: 92120708) A primary CTL response in cells from uninfected donors was detected by using a system where peptide was presented by human dendritic cells.

[McMichael & Walker(1994)] A. J. McMichael & B. D. Walker. Cytotoxic T lymphocytes epitopes: implications for HIV vaccine. *AIDS* **8S**:S155–S173, 1994.
NOTE: Comprehensive review summarizing CTL epitopes that have known HLA type and are fine mapped to indicate epitope boundaries. Anchor residues are indicated when known for different HLA restricted epitopes. Includes a summary of the published literature, as well as much work that was in press or submitted for publication.

[Meyerhans (1991)] A. Meyerhans, G. Dadaglio, J. P. Vartanian, P. Langlade-Demoyen, R. Frank, B. Asjo, F. Plata, & S. Wain-Hobson. *In vivo* persistence of a HIV-1-encoded HLA-B27-restricted cytotoxic T lymphocyte epitope despite specific *in vitro* reactivity. *Eur J Immunol* **21**:2637–2640, 1991.
NOTE: (Medline: 92008181) This study looked for the presence of CTL escape mutants *in vivo* in proviral DNA from an infected individual who had CTL activity; in 8 and 14 months escape mutants had not accumulated.

[Nixon & McMichael(1988)] D. Nixon & A. J. McMichael. Cytotoxic T-cell recognition of HIV proteins and peptides. *AIDS* **5**:1049–1059, 1988.

[Nixon (1988)] D. Nixon, A. Townsend, J. Elvin, C. Rizza, J. Gallway, & A. McMichael. HIV-1 gag-specific cytotoxic T lymphocytes defined with recombinant vaccinia virus and synthetic peptides. *Nature* **336**:484–487, 1988.
NOTE: (Medline: 89057146) p24 KRWIILGLNKIVRMY.

[Nixon (1990)] D. F. Nixon, S. Huet, J. Rothbard, M. Kieny, M. Delchambre, C. Thiriart, C. R. Rizza, F. M. Gotch, & A. J. McMichael. An HIV-1 and HIV-2 cross-reactive cytotoxic T-cell epitope. *AIDS* **4**:841–845, 1990.
NOTE: (Medline: 91069449) A HLA-B27 specific CTL clone from an HIV-1 infected individual that reacts with the Gag SF2 epitope KRWIILGLNKIVRMY also cross-reacts with the HIV-2 ROD analog RRWIQIGLQKSVRMY. The CTL also reacts with HIV-1 ELI KRWIIVGLNKIVRMY and SIVmm142 RRWIQLGLQKSVRMY, but only at very high concentration of peptide with SIVk6w78 RRWIQLRLQKSVRMY. The binding of the SIVk6w78 peptide to HLA-B27 does not seem to be reduced, so the authors suggest that the reduced ability to stimulate is in this case due to T-cell receptor interaction.

[Nixon & McMicheal(1991)] D. F. Nixon & A. J. McMicheal. Cytotoxic T-cell recognition of HIV proteins and peptides. *AIDS* **5**:1049, 1991.
NOTE: (Medline: 92029720) p17: LRPGGKKKYKLKHIV, HLA B8 and p24: VQNANPDCKTILKAL, HLA B8.

[Nowak (1995)] M. A. Nowak, R. M. May, R. E. Phillips, S. Rowland-Jones, D. G. Lalloo, S. McAdam, P. Klenerman, B. Koppe, K. Sigmund, C. R. M. Bangham, & A. J. McMichael. Antigenic oscillations and shifting immunodominance in HIV-1 infections. *Nature* **375**:606–611, 1995.
NOTE: (Medline: 95312083) This paper presents longitudinal studies of epitope variation and corresponding CTL responses in two patients. A mathematical model was created to provide a framework to explain the observed shifts in epitope and CTLp frequencies. For discussion, see also: J. M. Coffin, Nature 375:534-535 (1995).

[Parker (1994)] K. C. Parker, M. A. Bednarek, & J. E. Coligan. Scheme for ranking potential HLA-A2 binding peptides based on independent binding of individual peptide side-chains. *J Immunol* **152**, 1994.
NOTE: (Medline: 94075819) The authors conclude that peptide amino acid side-chain binding to the HLA-A2 molecule is independent of the sequence of the peptide, and developed a table of coefficients that can be used to help predict peptide binding to HLA-A2.

[Parker (1992)] K. C. Parker, M. A. Bednarek, L. K. Hull, U. Utz, B. C. H. J. Zweerink, W. E. Biddison, & J. E. Coligan. Sequence motifs important for peptide binding to the human MHC class I molecule, HLA-A2. *J Immunol* **149**, 1992.
NOTE: (Medline: 93056532).

[Phillips (1991)] R. E. Phillips, S. Rowland-Jones, D. F. Nixon, F. M. Gotch, J. P. Edwards, A. O. Ogunlesi, J. G. Elvin, J. A. Rothbard, C. R. Bangham, C. R. Rizza, & A. J. McMichael. Human immunodeficiency virus genetic variation that can escape cytotoxic T-cell recognition. *Nature* **354**:453–459, 1991.
NOTE: (Medline: 92086044) Fluctuations in the specificity of cytotoxic T-cells for HIV was correlated with variability in proviral gag (DNA) epitope sequences.

[Price (1995)] P. Price, R. P. Johnson, D. T. Scadden, C. Jassoy, T. Rosenthal, S. Kalams, & B. D. Walker. Cytotoxic CD8+ T lymphocytes reactive with human immunodeficiency virus-1 produce granulocyte/macrophage colony-stimulating factor and variable amounts of interleukins 2, 3, and 4 following stimulation with the cognate epitope. *Clinical Immunology and Immunopathology* **74**:100–106, 1995.
NOTE: (Medline: 95087232) Cyotkine release from stimulated CTL clones derived from either the peripheral blood or CSF of 3 patients was

studied. HLA restriction was determined for two of seven clones. GM-CSF and TNF-α and IFN-γ were produced by all clones; most clones produced low amounts of IL-2, IL-3, and IL-4.

[Rammensee (1995)] H.-G. Rammensee, T. Friede, & S. Stevanovic. Mhc ligands and peptide motifs: first listing. *Immunogenetics* **41**:178–228, 1995.
NOTE: (Medline: 95197186).

[Robertson (1993)] M. N. Robertson, F. Buseyne, O. Schwartz, & Y. Riviere. Efficient antigen presentation to cytotoxic T lymphocytes by cells transduced with a retroviral vector expressing the HIV-1 Nef protein. *AIDS Res and Human Retroviruses* **9**:1217–1223, 1993.
NOTE: (Medline: 94190626) This paper presents a retroviral vector system for antigen presentation to CTLs. As part of the controls to test their system, they study the response to specific nef peptides, which contain the dominant CTL epitopes in nef in their study subject.

[Rowland-Jones (1993)] S. L. Rowland-Jones, S. H. Powis, J. Sutton, I. Mockridge, F. M. Gotch, N. Murray, A. B. Hill, W. M. Rosenberg, J. Trowsdale, & A. J. McMichael. An antigen processing polymorphism revealed by HLA-B8-restricted cytotoxic T lymphocytes which does not correlate with TAP gene polymorphism. *Eur J Immunol* **23**:1999–2004, 1993.
NOTE: (Medline: 93345604) Individual fails to present HLA-B8-restricted influenza epitope, but can present an HLA-B8-restricted HIV-1 gag epitope.

[Rowland-Jones (1995)] S. L. Rowland-Jones, J. Sutton, K. Ariyoshi, T. Dong, , F. Gotch, S. McAdam, D. Whitby, S. Sabally, A. Gallimore, T. Corrah, M. Takiguchi, T. Schultz, A. McMichael, & H. Whittle. HIV-specific cytotoxic T-cells in HIV-exposed but uninfected Gambian women. *Nature Medicine* **1**:59–64, 1995.
NOTE: Four HIV-1 and -2 cross-reactive epitopes that are presented to CTL from HIV-infected Gambians by HLA-35 were identified. These peptides could elicit HIV specific CTLs from 3 of 6 repeatedly exposed but seronegative sex workers who carry the HLA-B35 allel. Most CTL derived from HIV-2 positive donors also recognized the HIV-2 peptide and the analogous HIV-1 peptide.

[Safrit (1994a)] J. T. Safrit, C. A. Andrews, T. Zhu, D. D. Ho, & R. A. Koup. Characterization of human immunodeficiency virus type 1-specific cytotoxic Tlymphocyte clones isolated during acute seroconversion: recognition of autologous virus sequences within a conserved immunodominant epitope. *J Exp Med* **179**:463–472, 1994a.
NOTE: (Medline: 94125027) HIV-1 specific CTL clones were isolated from two individuals at acute seroconversion. In one patient, two HLA A31-restricted clones recognized the same fragment of gp41, peptide RLRDLLLIVTR, but one was sensitive to a Thr to Val substitution, while the other was not. A CTL HLA A32-restricted clone from the other patient recognized the gp41 peptide VLSIVNRVRQGYSPLSFQTH. Autologous viral sequences from seroconversion were recognized by the CTL clones, but not the HIV-1 strain MN.

[Safrit (1994b)] J. T. Safrit, A. Y. Lee, C. A. Andrews, & R. A. Koup. A region of the third variable loop of HIV-1 gp120 is recognized by HLA-B7-Restricted CTLs from two acute seroconversion patients. *J Immunol* **153**:3822–3830, 1994b.
NOTE: (Medline: 95015873) HIV-1 envelope-specific CTL clones were isolated from the peripheral blood of two patients from within weeks of seroconversion. These clones were CD8+ and restricted by the HLA-B7 molecule. The minimum epitope was defined, RPNNNTRKSI, with

anchor residues at the proline and isoleucine; the anchor residues are relatively well conserved. A serine to arginine change at position 9 of the epitope abrogated clone recognition in one of the patients. This aa change is one factor that has been associated with a change from a nonsyncytium-inducing to a syncytium-inducing phenotype of HIV-1.

[Shirai (1992)] M. Shirai, C. D. Pendleton, & J. A. Berzofsky. Broad recognition of cytotoxic T cell epitopes from the HIV-1 envelope protein with multiple class I histocompatibiity molecules. *J Immunol* **148**:1657–1667, 1992.
NOTE: (Medline: 92176620) This paper explored the possibility that defined epitopes from HIV-1 env might be presented by multiple class I genes to CTLs using a murine system, isolating CTL from mice immunized with gp160 expressing recombinant vaccinia virus. The CTL epitope at the tip of the V3 loop (P18) was found to be presented by class I MHC molecules from four of ten haplotypes tested. Peptides that had previously been defined as helper T cell determinants (T1 in gp120, and HP53 (also called TH4.3)) were also able to stimulate CTL from mice with multiple haplotypes.

[Siliciano (1988)] R. Siliciano, T. Lawton, C. Knall, R. Karr, P. Berman, T. Gregory, & E. Reinherz. Analysis of host-virus interactions in AIDS with anti-gp120 T-cell clones: Effect of HIV sequence variation and a mechanism for CD4+ cell depletion. *Cell* **54**:561–575, 1988.
NOTE: (Medline: 88295131) This article demonstrated that a class II HLA-DR4 restricted response can be stimulated by CD4 uptake of gp120, suggesting a mechanism for T-cell depletion in vivo. This peptide containing the epitope was also able to stimulate a class I restricted, CD8+ CTL response.

[Sutton (1993)] J. Sutton, S. Rowland-Jones, W. Rosenberg, D. Nixon, F. Gotch, X. Gao, N. Murray, A. Spoonas, P. Driscoll, M. Smith, A. Willis, & A. McMichael. A sequence pattern for peptides presented to cytotoxic T lymphocytes by HLA B8 revealed by analysis of epitopes and eluted peptides. *Eur J Immunol* **23**:447–453, 1993.
NOTE: (Medline: 93170395).

[Takahashi (1988)] H. Takahashi, J. Cohen, A. Hosmalin, K. B. Cease, R. Houghten, J. L. Cornette, C. DeLisi, B. Moss, R. N. Germain, & J. A. Berzofsky. An immunodominant epitope of the human immunodeficiency virus envelope glycoprotein gp160 recognized by class I major histocompatibility complex molecule-restricted murine cytotoxic T lymphocytes. *Proc Natl Acad Sci USA* **85**:3105–3109, 1988.
NOTE: (Medline: 88203649) Mice were infected with a recombinant vaccinia virus expressing the HIV gp160 envelope gene, and the primed lymphocytes were restimulated *in vitro* with a transfected histocompatible cell line expressing the same gene. H-2^d mice respond predominantly to a single immunodominant site represented by a 15-residue synthetic peptide.

[Takahashi (1989a)] H. Takahashi, R. Houghten, S. D. Putney, D. H. Margulies, B. Moss, R. N. Germain, & J. A. Berzofsky. Structural requirements for class I MHC molecule-mediated antigen presentation and cytotoxic T-cell recognition of an immunodominant determinant of the human immunodeficiency virus envelope protein. *J Exp Med* **170**:2023–2035, 1989a.
NOTE: (Medline: 90063467) Murine BALBc CTL Class I D^d cells elicited by HIV-1 IIIB peptide: RIQRGPGRAFVTIGK.

[Takahashi (1989b)] H. Takahashi, S. Meril, S. D. Putney, R. Houghten, B. Moss, R. N. Germain, & J. A. Berzofsky. A single amino acid interchange yields reciprocal CTL specificities for HIV-1 gp160. *Science* **246**:118–121, 1989b.

anchor residues at the proline and isoleucine; the anchor residues are relatively well conserved. A serine to arginine change at position 9 of the epitope abrogated clone recognition in one of the patients. This aa change is one factor that has been associated with a change from a nonsyncytium-inducing to a syncytium-inducing phenotype of HIV-1.

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[Sutton (1993)] J. Sutton, S. Rowland-Jones, W. Rosenberg, D. Nixon, F. Gotch, X. Gao, N. Murray, A. Spoonas, P. Driscoll, M. Smith, A. Willis, & A. McMichael. A sequence pattern for peptides presented to cytotoxic T lymphocytes by HLA B8 revealed by analysis of epitopes and eluted peptides. *Eur J Immunol* **23**:447–453, 1993.
NOTE: (Medline: 93170395).

[Takahashi (1988)] H. Takahashi, J. Cohen, A. Hosmalin, K. B. Cease, R. Houghten, J. L. Cornette, C. DeLisi, B. Moss, R. N. Germain, & J. A. Berzofsky. An immunodominant epitope of the human immunodeficiency virus envelope glycoprotein gp160 recognized by class I major histocompatibility complex molecule-restricted murine cytotoxic T lymphocytes. *Proc Natl Acad Sci USA* **85**:3105–3109, 1988.
NOTE: (Medline: 88203649) Mice were infected with a recombinant vaccinia virus expressing the HIV gp160 envelope gene, and the primed lymphocytes were restimulated *in vitro* with a transfected histocompatible cell line expressing the same gene. H-2^d mice respond predominantly to a single immunodominant site represented by a 15-residue synthetic peptide.

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NOTE: (Medline: 90063467) Murine BALBc CTL Class I D^d cells elicited by HIV-1 IIIB peptide: RIQRGPGRAFVTIGK.

[Takahashi (1989b)] H. Takahashi, S. Meril, S. D. Putney, R. Houghten, B. Moss, R. N. Germain, & J. A. Berzofsky. A single amino acid interchange yields reciprocal CTL specificities for HIV-1 gp160. *Science* **246**:118–121, 1989b.

NOTE: (Medline: 89388278) Murine BALBc CTL Class I D^d epitope elicited by HIV-1 IIIB and MN gp160 vaccinia construct, stimulated with peptides: RIQRGPGRAFVTIGK, IIIB and RIHIGPGRAFYTTKN, MN. These two peptides were non-cross reactive. Val/Tyr exchange was sufficient to interchange the specificities of the two peptides.

[Takahashi (1992)] H. Takahashi, Y. Nakagawa, C. D. Pendleton, R. Houghten, K. Yokomuro, R. N. Germain, & J. A. Berzofsky. Induction of broadly cross-reactive cytotoxic T-cells recognizing and HIV-1 envelope determinant. *Science* **255**:333–336, 1992.
NOTE: (Medline: 92196580) Murine BALBc CTL Class I epitope elicited by HIV-1 RF, IIIB and MN gp160 vaccinia construct, stimulated with peptides: SITKGPGRVIYATGQ, RF; RIQRGPGRAFVTIGK, IIIB; and RIHIGPGRAFYTTKN, MN.

[Takahashi (1991)] K. Takahashi, L. Dai, T. R. Fuerst, W. E. Biddison, P. L. Earl, B. Moss, & F. A. Ennis. Specific lysis of human immunodeficiency virus type 1-infected cells by a HLA-A3.1-restricted CD8+ cytotoxic T-lymphocyte clone that recognizes a conserved peptide sequence within the gp41 subunit of the envelope protein. *Proc Natl Acad Sci USA* **88**:10277–10281, 1991.
NOTE: (Medline: 92052253) gp41 epitope: RLRDLLLIVTR, HLA A3.1 (NL43). Synthetic peptides of RF and CDC4 were recognized by CTL clone despite non-conservative Thr to (Val or Ala) change, but an MN peptide with four natural substitutions was not recognized.

[Tsomides (1994)] T. J. Tsomides, A. Aldovini, R. P. Johnson, B. D. Walker, R. A. Young, & H. N. Eisen. Naturally processed viral peptides recognized by cytotoxic T lymphocytes on cells chronically infected by human immunodeficiency virus type 1. *Journal of Experimental Medicine* **180**:1283–1293, 1994.
NOTE: (Medline: 95016420) Naturally processed peptides can by purified from trifluoroacetic acid lysates of HIV-1 infected cells. A gag and RT epitope were compared; both synthetic peptides are optimally active in CTL assays. The naturally processed gag peptide was more abundant than the RT peptide in HIV-1 infected HLA-A2 positive cells, and the gag specific CTL more effective, suggesting surface density of peptides may influence efficiency of CTL killing.

[Tsomides (1991)] T. J. Tsomides, B. D. Walker, & H. N. Eisen. An optimal viral peptide recognized by CD8+ T-cells binds very tightly to the restricting class I major histocompatibility complex protein on intact cells but not to the purified class I protein. *Proc Natl Acad Sci USA* **88**:11276–11280, 1991.
NOTE: (Medline: 92107932).

[van Baalen (1993)] C. A. van Baalen, M. R. Klein, A. M. Geretti, R. I. P. M. Keet, F. Miedema, C. A. C. M. van Els, & A. D. M. E. Osterhaus. Selective *in vitro* expansion of HLA class I-restricted HIV-1 Gag-specific CD8+ T-cells: cytotoxic T-lymphocyte epitopes and precursor frequencies. *AIDS* **7**:781–786, 1993.
NOTE: (Medline: 93371704) Gag specific epitopes and precursor frequencies were studied in seven individuals; for CTLs from one individual, fine mapping was done using peptides. PFA-fixed rVV-Gag-infected B-LCL cells were used as stimulator cells of bulk PBMC cultures to determine precursor frequencies and identify epitopes.

[Walker (1989)] B. D. Walker, C. Flexner, K. Birch-Limberger, L. Fisher, T. J. Paradis, A. Aldovini, R. Young, B. Moss, & R. T. Schooley. Long-term culture and fine specificity of human cytotoxic T-lymphocyte clones reactive with human immunodeficiency virus type 1. *Proc Natl*

Acad Sci USA **86**:9514–9518, 1989.
NOTE: (Medline: 90083298) Seven HIV-1 reverse transcriptase-specific cytotoxic T-lymphocyte (CTL) clones from the peripheral blood of two seropositive subjects were generated. Five different HLA restricted CTL epitopes were identified by peptide mapping.

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NOTE: (Medline: 93211933).